

**WHAT IS CLAIMED IS:**

1           1.    A system for estimating inputs and outputs of a  
2   digital transmission system, comprising:

3           a receiver front-end configured to receive an observed  
4   digital signal in the digital transmission system;

5           a forward recursion element adapted to receive the  
6   observed digital signal, and generate a first sequence of  
7   soft information by performing a forward recursion;

8           at least one forward channel estimator adapted to  
9   receive the observed digital signal and said first sequence  
10   of soft information, said at least one forward channel  
11   estimator operating to estimate channel parameters using  
12   said first sequence of soft information;

13          a backward recursion element adapted to receive the  
14   observed digital signal, and generate a second sequence of  
15   soft information by performing a backward recursion;

16          at least one backward channel estimator adapted to  
17   receive the observed digital signal and said second sequence  
18   of soft information, said at least one backward channel  
19   estimator operating to estimate channel parameters using  
20   said second sequence of soft information; and

21          a combiner configured to compute a transitional  
22   information that ties forward and backward estimates of said  
23   first and second sequences of soft information together,  
24   said combiner operating to generate soft information on the

25 inputs and outputs of the transmission system by combining  
26 updated first and second sequences of soft information and  
27 said transitional information.

1 2. The system of claim 1, wherein said forward  
2 recursion element is a Trellis-based forward operator, and  
3 said backward recursion element is a Trellis-based backward  
4 operator,

5 where each operator generates a sequence of Trellis  
6 state soft information updates.

1 3. The system of claim 2, wherein each of said  
2 Trellis-based forward operator and backward operator is a  
3 min/sum operator.

1 4. The system of claim 3, wherein each of said  
2 min/sum operators performs min/sum operations on said  
3 sequence of Trellis state soft information updates.

1 5. The system of claim 4, wherein each of said  
2 min/sum operators computes soft output for the inputs and  
3 outputs defined by Trellis state transition.

1           6.    The system of claim 5, wherein said soft output  
2   for the inputs and outputs defined by Trellis state  
3   transition is computed as min/sum of a starting state  
4   forward soft information, said Trellis state transition, an  
5   ending state backward soft information, and a binding  
6   factor.

1           7.    The system of claim 2, wherein each of said  
2   Trellis-based forward and backward operators is a  
3   sum/product operator.

1           8.    The system of claim 2, wherein each of said  
2   Trellis-based forward and backward operators is a  
3   min/product operator.

1           9.    The system of claim 2, wherein each of said  
2   Trellis-based forward and backward operators is a  
3   max/product operator.

1           10.   The system of claim 2, wherein each of said  
2   Trellis-based forward operator and backward operator is a  
3   min\*/sum operator.

1           11. The system of claim 2, wherein each of said  
2 forward and backward operators includes a Kalman filter  
3 channel estimator for each Trellis state.

1           12. The system of claim 2, wherein each of said  
2 forward and backward operators includes a least mean-square  
3 estimator for each Trellis state.

1           13. The system of claim 2, wherein each of said  
2 forward and backward operators includes a non-linear  
3 estimator for each Trellis state.

1           14. The system of claim 13, wherein said non-linear  
2 estimator is a phase-locked loop.

1           15. The system of claim 2, wherein each of said  
2 forward and backward operators includes an open-loop  
3 estimator for each Trellis state.

1           16. A method for estimating inputs and outputs of a  
2 digital transmission system, comprising:

3               receiving an observed digital signal in the  
4 digital transmission system;

5               generating a first sequence of soft information by  
6 performing a forward recursion;

7               estimating channel parameters using said first  
8       sequence of soft information and said observed digital  
9       signal;

10             generating a second sequence of soft information  
11     by performing a backward recursion;

12             estimating channel parameters using said second  
13     sequence of soft information and said observed digital  
14     signal;

15             computing a transitional information that ties  
16     forward and backward estimates of said first and second  
17     sequences of soft information together; and

18             generating soft information on the inputs and  
19     outputs of the transmission system by combining updated  
20     first and second sequences of soft information and said  
21     transitional information.

1           17. An iterative receiver system, comprising:  
2           a channel processor configured to receive a  
3 plurality of coded symbols, said channel processor operating  
4 to produce and update soft information on said plurality of  
5 coded symbols, where said channel processor is activated by  
6 updated soft information on interleaved code symbols;  
7           a soft-in/soft-out decoder configured to receive  
8 said soft-information on said plurality of coded symbols,  
9 said soft-in/soft-out decoder operating to compute soft  
10 information on said coded symbols; and  
11           an interleaver/de-interleaver pair operating to  
12 pass said soft information to/from said channel processor  
13 from/to said soft-in/soft-out decoder,  
14           where after several iterations, final bit  
15 decisions are made on uncoded bits by said soft-in/soft-out  
16 decoder by thresholding the corresponding soft information  
17 produced by said soft-in/soft-out decoder.